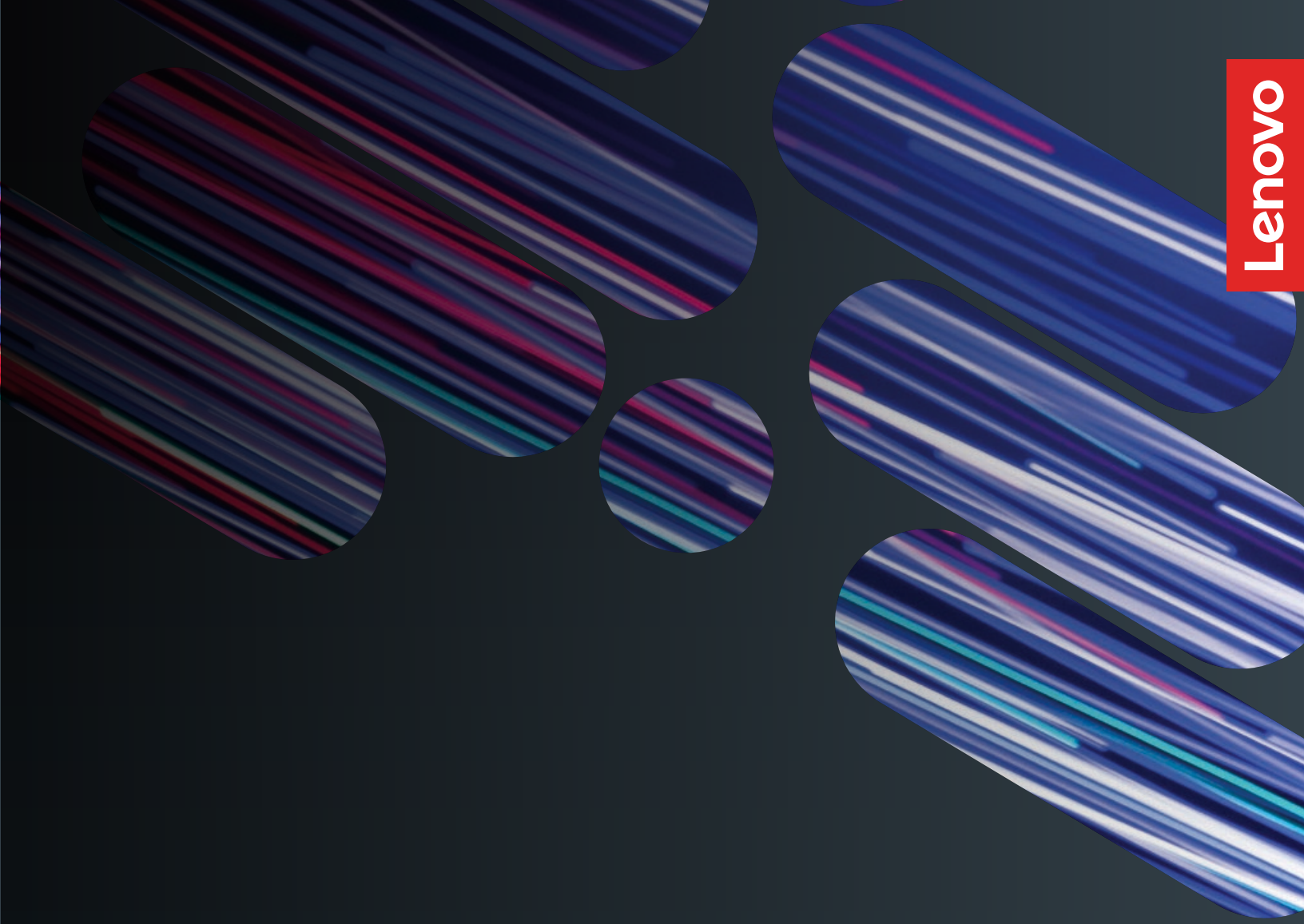


NUTANIX

LENOVO THINKAGILE HX SOLUTION FOR SAP APPLICATIONS

SAP Global Partner

Lenovo and Nutanix share a common vision of delivering an invisible infrastructure for SAP applications that is quick to deploy and simple to maintain. This document presents a joint infrastructure solution for customers deploying SAP Business Suite applications with the SAP HANA® database, including:

- SAP S/4HANA®, SAP Business Suite, and NetWeaver® application workloads on Lenovo ThinkAgile HX Series converged platforms
- The SAP HANA database on certified appliances from Lenovo

The Nutanix Enterprise Cloud Platform is certified for SAP application landscapes including SAP S/4HANA, SAP Business Suite, SAP Business Warehouse and SAP Solution Manager. The Nutanix Enterprise Cloud Platform running on Lenovo ThinkAgile HX Series offers:

- Localized I/O and flash for index and key database files, enabling low latency operations
- Non-disruptive upgrades and scalability, including one-click node addition with no system downtime
- Nutanix VM and app-centric data protection and disaster recovery, including automated backups
- Consumer-grade simplicity for storage management, eliminating complicated configurations, manual provisioning, and mapping with disks, RAID, and LUNs

The Lenovo ThinkAgile HX systems powered by Nutanix software is simple to deploy. With compute, storage, and virtualization co-located on a single node, the Lenovo ThinkAgile HX enables you to dramatically simplify your server, storage, and virtualization deployments and pool your resources into a single virtualized infrastructure for more flexible and efficient utilization and management. Plus, it scales rapidly to meet the growing needs of your business. Lenovo designsits platforms with open standards, enabling easy integration with third-party partners for best-in-class offerings.

By delivering an invisible infrastructure that is quick to deploy and simple to maintain, Lenovo and Nutanix allow IT resources to focus on delivering applications and drive innovation, greater efficiency, and agility for the business, instead of managing complex infrastructures.

SAP Landscape Logical Design

Figure 1 illustrates the logical design of the Hyperconverged Infrastructure Framework for SAP application landscapes and SAP HANA running on certified HANA appliances from Lenovo. The figure depicts the distribution of different roles across the infrastructure. The left side presents SAP S/4HANA, SAP Business Suite, and SAP NetWeaver Application Servers and the supporting workloads, and the right side shows the Intel Xeon Scalable Processor Family based Lenovo appliances for SAP HANA that run the SAP HANA databases.

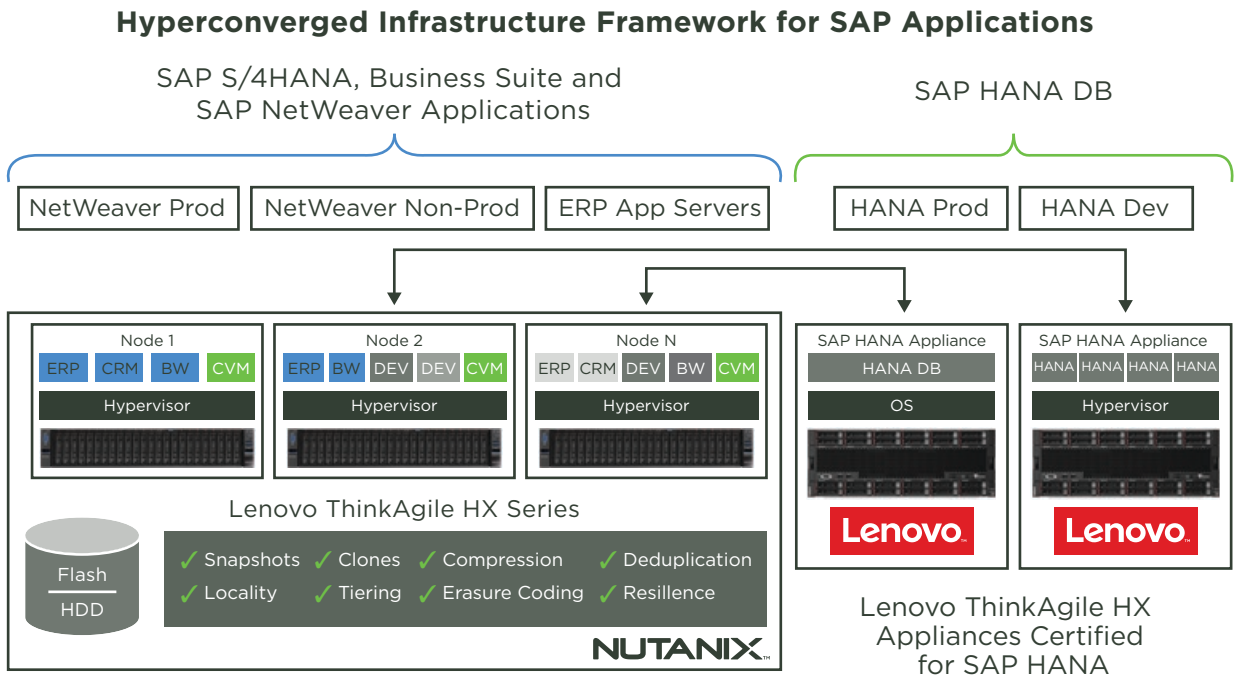


Figure 1: SAP Landscape Logical Design

Nutanix Solution for SAP Physical Design

Because the SAP HANA database runs on separate, physical appliances, we recommend at least 10 Gb network connectivity between the appliances and the other SAP solution components. Lenovo converged appliances provide 10 Gb Ethernet uplinks by default. This structure allows for optimal connectivity between nodes, connecting the hyperconverged nodes to the physical SAP HANA appliances for data access. Figure 2 illustrates the SAP landscape with HANA appliances on Lenovo ThinkAgile HX for SAP systems.

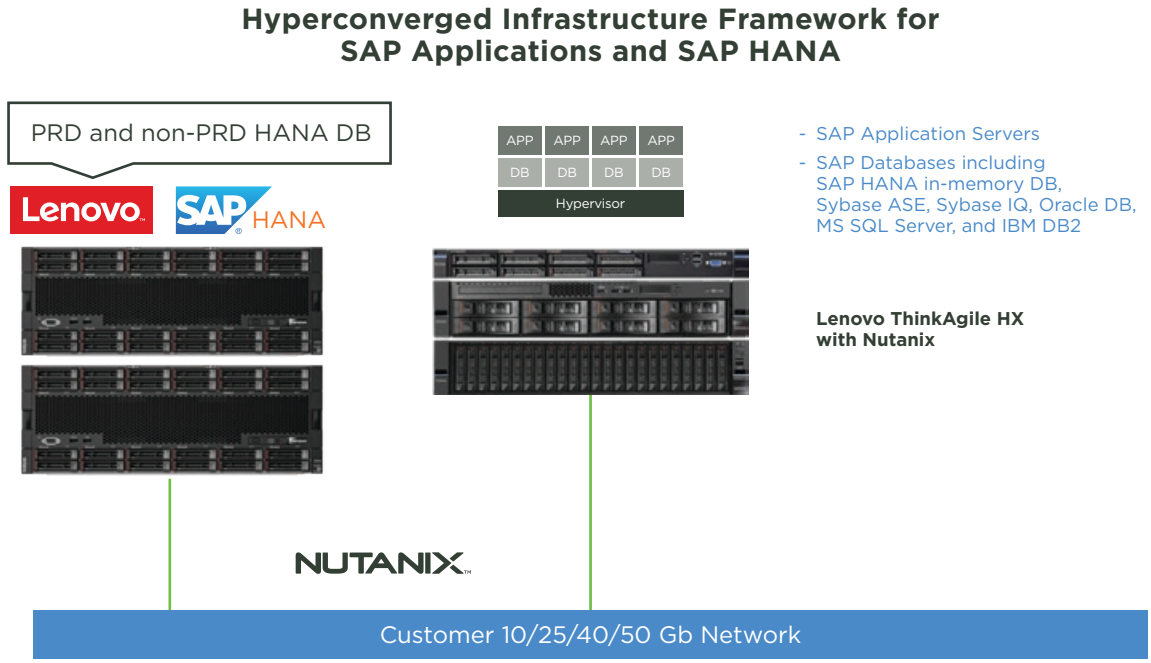


Figure 2: SAP Landscape with ThinkAgile HX Appliances for SAP HANA and SAP Applications

Hyperconverged Infrastructure Framework for SAP Applications and SAP HANA

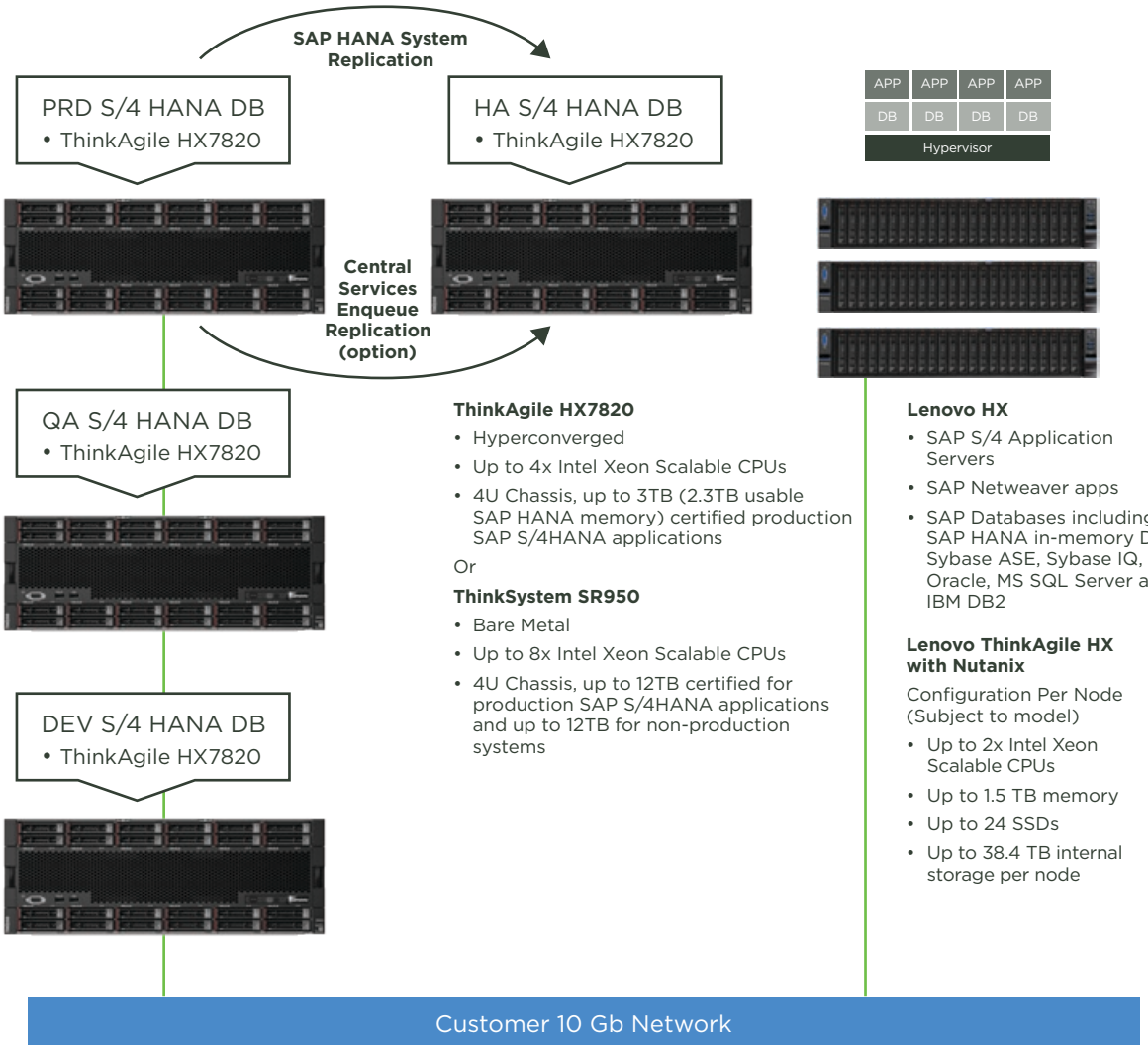


Figure 3: SAP Application Landscape with Lenovo ThinkAgile HX appliances for SAP HANA and Lenovo ThinkAgile HX with Nutanix for SAP S/4HANA, SAP Business Suite and SAP NetWeaver Applications

Sizing SAP S/4HANA, SAP Business Suite and SAP NetWeaver Application Requirements

The surrounding SAP application servers and tools for deploying, implementing, and operating an SAP environment require significant resources. All of these components can run on the Lenovo ThinkAgile HX converged platform powered by Nutanix software.

The following section highlights the most important considerations when sizing Lenovo ThinkAgile HX systems with Nutanix for SAP S/4HANA Business Suite NetWeaver workloads. We strongly recommend that you engage Lenovo's SAP Center of Competence (CoC) for tailored, enterprise-specific needs.

Sizing SAP NetWeaver on Lenovo ThinkAgile HX with Nutanix Platform

When sizing for an HX Nutanix-based SAP landscape implementation, be sure to take these considerations into account. Some pertain to virtualization and others to hyperconverged infrastructure—the core building block of the Nutanix Enterprise Cloud Platform.*

CVM Utilization

Hyperconverged infrastructure provides storage services from inside the physical appliance, eliminating the need to design, implement, and maintain complex storage network infrastructures.

The Nutanix Acropolis Distributed Storage Fabric (DSF) uses a Controller VM (CVM) to provide storage services and the required storage IOPS for virtual machines. The CVM uses four cores, on average, from each application node to fulfill its function and services; these cores provide analytics and management services to the cluster. When sizing the SAP landscape, subtract these cores from those available to run SAP workloads.

When sizing the SAP HANA database, the **minimum size** of a virtual SAP HANA instance is a full socket (represented by at least 8 **physical cores**). The minimum SAP HANA database size is **128GB** of **RAM**. The **maximum size** of a virtual SAP HANA instance is limited by the maximum size of a virtual machine on Nutanix AHV release, which is **168 vCPUs** on 3 Sockets (3 Sockets only on 4 Socket Hardware), and **2.3TB** of **RAM**.

Virtualization

CPU: Because virtualization introduces a small amount of overhead for the running workloads, it is a common practice to account for this overhead by reducing available CPU resources by 10%.

Memory: Nutanix and SAP do not support memory over-commitment for production SAP systems, so be sure to reserve all assigned memory. This includes taking into account the virtualization memory overhead per VM and sufficient resources to allow for failure and maintenance.

NUMA: When designing the VM layout for SAP application workloads, it is important to account for the physical non-uniform memory architecture (NUMA) layout of the underlying physical hosts. Creating "wide" VMs can lead to suboptimal memory access performance due to remote NUMA memory access patterns.

Although hypervisors like VMware ESXi have scheduler mechanisms to optimize VM placement, we recommend sizing VMs so they stay within the borders of a local NUMA node. For additional information on NUMA considerations and ESXi, see VMware's SAP HANA on VMware vSphere Best Practices Resources Guide.

*2686722 - SAP HANA virtualized on Nutanix Acropolis Hypervisor
https://launchpad.support.sap.com/#/notes/ 2686722
Note that the configuration and overall setup must comply with the latest version of the best practice guide http://download.nutanix.com/solutionsDocs/BP-2097-SAP-HANA.pdf

Three-tier application architecture implementations allow for better VM distribution across nodes, because they make it easier to achieve NUMA alignment. Although a three-tier application architecture is recommended, the hyperconverged implementation also supports using a bigger VM and implementing a two-tier application architecture design.

CPU Oversubscription

Lenovo and Nutanix recommend following the SAP best practice of not oversubscribing CPU and memory for production systems (assign 1:1 CPU and memory resources). It is not recommended to oversubscribe QA systems. Development and test systems can use 1.5-2:1 CPU oversubscription. Make adjustments as needed based on observed behavior.

Storage IOPS

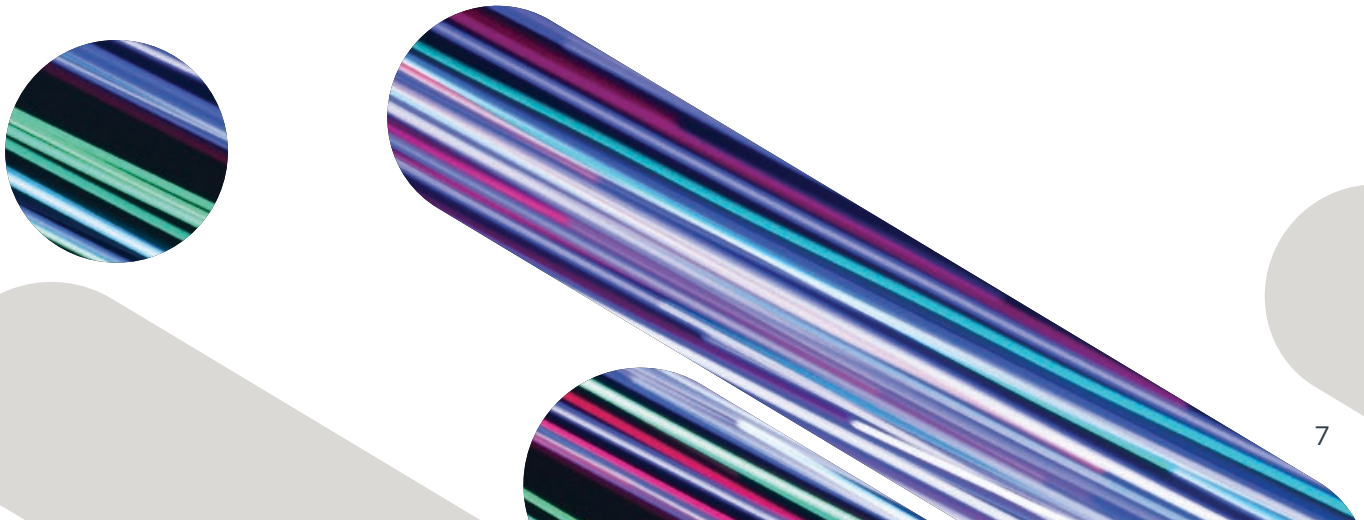
Designing the correct storage system configuration is a more involved part of SAP S/4HANA Business Suite NetWeaver application sizing. Storage IOPS requirements depend heavily on which SAP application you use and how you implement customer-specific customizations. Early Watch Alert reports provide sufficient information for migrating existing implementations onto the Lenovo ThinkAgile HX Series and Nutanix platform.

Lenovo provides a variety of hyperconverged appliances or node types with different combinations of SSDs and hard disks. In addition, there are all-flash options for designing a high-performance solution that provides the necessary IOPS for implementations of all sizes. After right-sizing the CPU and memory resources, the resulting system can deliver the required storage IOPS for most SAP applications. Please consult the Lenovo CoC team for a detailed analysis of your requirements. It's simple to add storage capacity with storage nodes that provide additional storage capacity but can't run VMs and don't require hypervisor licenses. You can use this additional capacity for a variety of tasks, such as backups or additional snapshots.

Active Working Set Size in Hybrid Hyperconverged Systems

With hybrid hyperconverged systems, it's important to correctly size the SSD tier for planned workloads. The SSD must be large enough to hold the application's complete active working set; this is especially true for the database server. In this solution, we are primarily concerned with the SAP database working set, as the application server part of an SAP system rarely changes and writes only application log files.

Calculating the exact working set size is a nontrivial task, but Nutanix and Lenovo have developed an effective and relatively simple approach. Extract the database monthly change rate from your Solution Manager monitoring tools or database growth data. Take the largest delta from a data set, multiply it by three, and this gives you a good working set estimate for that SAP instance. To calculate the working set of the entire cluster, repeat the above for all SAP instances in your environment. You don't need to calculate working set size for all-flash nodes.



Hypervisor Selection

Nutanix supports three different hypervisors for their Enterprise Cloud Platform: VMware ESXi, Microsoft Hyper-V, and the native Nutanix hypervisor, AHV. At this time, VMware ESXi, Microsoft Hyper-V and AHV are certified for virtualizing SAP Business Suite NetWeaver workloads. Nutanix AVH is the only hypervisor supported for hyperconverged SAP HANA implementations.

Adjusting SAP Benchmark Results for Production Implementations

The publicly available SAP benchmarks that show SAP Application Performance Standard (SAPS) results are designed to maximize usage of the existing CPU resources, which often leads to assuming CPU usage of 96% to 99%. However, neither SAP architects nor customers run their systems with such high CPU loads. It is common practice to scale down the existing benchmark's defined CPU usage results to 65% for optimal sizing results.

Sizing Calculation Example

Table 1 provides a sample calculation for estimating the available, usable SAPS capacity of any usable SAPS capacity of any application server node. In this example, we assume the following:

- A two-socket Intel Xeon Scalable Processor Family
- 22 cores / 44 threads
- A Sales and Distribution (SD) benchmark of approximately 100,000 SAPS at 96% CPU load

Adjusting for production utilization	(100,000 SAPS/96) × 65 = 67,708 SAPS @65% CPU Load
Virtualization overhead	67,708 SAPS - 10% = 60,937 SAPS virtualized
Accounting for CVM (4 cores)	(60,937/22) × 18 = 49,857 SAPS available per node
Note: We don't take hyperthreading into account. It's used as headroom to compensate for spikes in usage, such as monthly or quarter-end processing.	
For more information on SAP benchmarks, please visit www.sap.com/benchmarks.	

Table 1: Sizing Calculation Example

Sizing the SAP HANA Database

Sizing SAP HANA is a complex task that requires significant expertise. Correct sizing depends heavily on the usage scenario for the SAP HANA database. Accordingly, we recommend working with SAP directly to define the required SAP HANA solution.

SAP can provide guidance around the different usage scenarios for HANA and the recommended sizing approach for each:

- Note 2686722: SAP HANA virtualized on Nutanix Acropolis Hypervisor
- Note 1514966: SAP HANA 1.0: Sizing SAP In-Memory Database
- Note 1637145: SAP NetWeaver BW on HANA: Sizing SAP In-Memory Database
- Note 1793345: Sizing for SAP Suite on HANA
- Note 1872170: Suite on HANA Memory Sizing

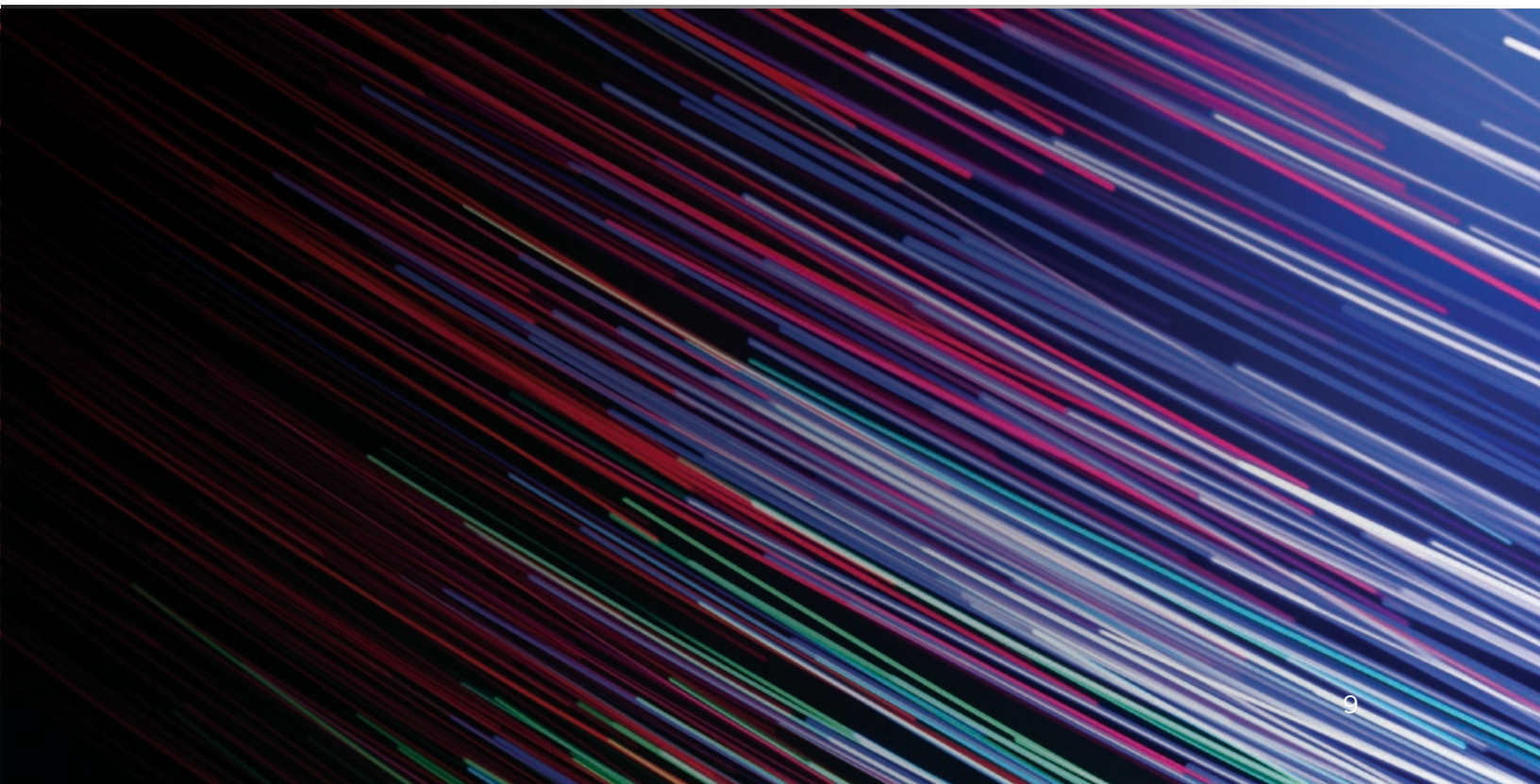
You'll need a valid SAP S-User ID to access these documents. You can also refer to the SAP Quick Sizer.

For more detailed information on SAP HANA solutions tailored for your enterprise, contact your Lenovo sales representative or Business Partner. You can also review the following Lenovo documents regarding SAP HANA solutions:

- SAP Solutions on Lenovo Servers
- SAP HANA with VMware vSphere on System x for Production Environments
- In-memory Computing with SAP HANA on Lenovo X6 Systems

Learn More

To learn more about Lenovo and Nutanix infrastructure solutions for SAP applications, visit www.lenovo.com/sap



About Nutanix

Nutanix makes infrastructure invisible, elevating IT to focus on the applications and services that power their business. The Nutanix Enterprise Cloud Platform leverages web-scale engineering and consumer-grade design to natively converge compute, virtualisation and storage into a resilient, software-defined solution with rich machine intelligence. The result is predictable performance, cloud-like infrastructure consumption, robust security, and seamless application mobility for a broad range of enterprise applications. Learn more at www.nutanix.com or follow us on Twitter @nutanix.

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